2016 UDOT RESEARCH PROBLEM STATEMENT

****** Problem statement deadline is March 14, 2016. Submit statements to Tom Hales at tahales@utah.gov. ******

Title: The Effect of Air Quality on Transit Ridership Patterns and Associated Vehicle Emissions **No. (office use):** 16.06.11

Submitted By: John C. Lin

Organization: University of Utah

Email: john.lin@utah.edu

Phone: 801-581-7530

UDOT Champion (suggested): Hal Johnson

Select One Subject Area

- ☐ Materials/Pavements
- ☐ Preconstruction
- ☐ Maintenance
- ☐ Planning
- ☐ Traffic Mgmt/Safety
- ☒ Public Transportation

1. Describe the problem to be addressed.

Salt Lake County regularly experiences meteorological inversions during cold-weather months; these lead to periods of poor air quality (AQ). During such "inversion events", transit riders are motivated by competing factors:

- Limited access to transit or insensitivity to the collective AQ issue could inspire NO CHANGE in transit commuting behavior.
- Social virtue may move riders to commute MORE via transit.
- Personal health concerns from exposure to pollutants en route to or from transit vehicles, or while transferring between them, may motivate riders to commute LESS via transit.

UTA presently has limited knowledge regarding how ridership on their system varies in response to air pollution events – e.g. volume, timing, spatial distribution, and composition of ridership, as well as sensitivity of ridership changes to degree of air quality. This challenges decision-makers’ ability to consider transit-related policies (e.g. subsidized fare reductions on bad air days) that could influence AQ during inversion events. UTA has a rich database of rider activity generated through their Tap On/Tap Off (TOTO) fare system; these data contain information that could inform these deficiencies.

2. Explain why this research is important.

The Salt Lake Valley (SLV) already experiences some of the worst air in the nation during inversion events. Expected population growth in SLV will likely increase all of the following:

- Pollutant concentrations, due to growth driven emissions;
- Per-capita exposure, due to growth-related traffic congestion as well as increased pollutant concentration; and
- Aggregate societal cost (e.g. emergency medical care; lost worker productivity, etc.), due to increased per-capita exposure as well as growth in total exposed population.

Increased transit ridership may slow the decline of air quality during adverse events and may limit its worst extremes. UTA transit usage therefore represents an important element of society’s potential response to the region’s air quality problem. Quantifying the sensitivity of transit ridership to pollution events can help guide policy-making intended to reduce the negative impacts of inversion events.

3. List the research objective(s):

1. Identify and quantify patterns of travel behavior by individual (anonymized) UTA riders, specifically identify commute v. non-commute trips.
2. Determine whether ridership patterns (at individual and aggregate scales) vary systematically during bad air quality events, and if so, examine the size and behaviors (i.e. AQ elasticity of ridership) of populations that increase and/or decrease transit commuting.
3. Estimate the monetary fare value of hypothetical free fares during bad air quality events, given scenario ridership volumes up to the maximum observed in the TOTO data; also estimate the emissions reductions and potential air quality impacts associated with such ridership.

4. List the major tasks:

1. Classify trips for each unique UTA rider account ID over study years 2011-2016, by commute/non-commute nature and by DEQ air quality (green, yellow, orange, red) on the day of travel.
2. Analyze the total volume of trips used for commuting/non-commuting, and relationships between transit use and poor air quality days.
3. Estimate transit emissions, avoided personal vehicle emissions (i.e. auto emissions for equivalent trips), and good v. poor air quality day pollutant concentration differences, for TOTO trips attributable to AQ-induced transit ridership changes.
4. Estimate expected monetary cost of reduced fare on transit system, and model associated changes in emissions and potential air quality impacts.

5. List the expected results:

Expected Findings:

1. We expect that the TOTO data will allow us to differentiate between commute and non-commute trips on a per-rider basis.
2. We anticipate that we will observe distinguishable populations who are more, less, and equally likely to commute via UTA during inversion events.
3. We expect that commute ridership will be more responsive to AQ in wealthier neighborhoods (i.e. greater flexibility due to financial options) than in poorer neighborhoods.
4. We hypothesize that non-commute ridership will be more sensitive to poor air quality than commute ridership, because these trips are more likely to be discretionary.

Project Outputs

1. Quantitative assessment of TOTO ridership's commute and non-commute travel behaviors.
2. Quantitative assessment of AQ elasticity of UTA transit use demand.
3. Spatial and temporal patterns of transit emissions and avoided private vehicle emissions, and differences in associated pollutant concentrations between good and poor air quality days.
4. Estimates of direct fare costs attributable to changes in UTA transit ridership during bad air quality events.

6. Describe how this research will be implemented.

1. This research will inform UTA on the spatial and temporal relationships between ridership and poor air quality.
2. This research will provide a basis for future analyses of economic benefit:cost ratios by quantifying emissions reductions associated with scenario fare subsidies.

7. Requested from UDOT: $20K **Other/Matching Funds:** $25K **Total Cost:** $45K
(or UTA for Public Transportation)

8. Outline the proposed schedule, including start and major event dates.

The following schedule serves as a guideline of the relative timing of the major event dates. The University of Utah will work with the research manager and project champion to finalize the schedule and scope.

1) Proposed Start Date: August 31, 2016
2) Submit Detailed Work Plan: November 18, 2016
3) Classify trips for each unique account ID by purpose and air quality on day of travel: January 27, 2017
4) Analyze transit use on good and poor air quality days, by purpose of travel (commute/non-commute): February 24, 2017
5) Characterize transit emissions differences between good and poor air quality days: April 21, 2017
6) Quantify monetary cost of reduced transit fares during poor air quality days: July 14, 2017
7) Draft Final Report: October 20, 2017
8) Final Report: December 22, 2017